

REMARKS

The Office action mailed on 30 May 2003 (Paper No. 5) has been carefully considered.

The specification and Abstract are being amended to correct minor errors and improve form. Claims 2, 8, 9, 18, 19, 24, 30 and 31 are being canceled without prejudice or disclaimer, claims 1, 3 thru 7, 10, 12 thru 17, 20 thru 23, 25 thru 29 and 32 thru 34 are being amended, and claims 35 thru 47 are being added. Thus, claims 1, 3 thru 7, 10 thru 17, 20 thru 23, 25 thru 29 and 32 thru 47 are pending in the application.

In paragraphs 1 and 2 of the Office action, the Examiner objected to the title of the invention as being non-descriptive. Accordingly, the title has been amended to read *"CATHODE FOR ELECTRON TUBE HAVING NEEDLE-SHAPED CONDUCTIVE MATERIAL AND METHOD OF PREPARING THE CATHODE"* as the Examiner kindly suggested. Withdrawal of the objection to the title therefore is requested.

In paragraph 4 of the Office action, the Examiner rejected claims 1 thru 3, 8 thru 13, 18, 19, 23 thru 25, 30 and 31 under 35 U.S.C. §102 for alleged anticipation by Koizumi, U.S. Patent No. 5,216,320. In paragraph 11 of the Office action, the Examiner rejected claims 1 thru 5, 8 thru 10, 12 thru 15, 18, 19, 23 thru 27, 30 and 31 under 35 U.S.C. §102 for alleged anticipation by Uemura, U.S. Patent No. 6,239,547. In paragraph

20 of the Office action, the Examiner rejected claims 6, 7, 16, 17, 28 and 29 under 35 U.S.C. §103 for alleged unpatentability over Koizumi '320 and Uemura '547. In paragraph 23 of the Office action, the Examiner rejected claims 20 thru 22 and 32 thru 34 under 35 U.S.C. §103 for alleged unpatentability over Koizumi '320 in view of Ando, U.S. Patent No. 4,349,766. For the reasons stated below, it is submitted that the invention recited in the claims, as now amended, is distinguishable from the prior art cited by the Examiner so as to preclude rejection under 35 U.S.C. §102 or §103.

Independent claims 1 and 23 are being amended to include the recitations of dependent claims 2 and 24, respectively, which are being canceled. Thus, independent claims 1 and 23 now recite that the needle-shaped conductive material is at least material selected from a group consisting essentially of carbon, indium tin oxide, nickel, magnesium, rhenium, molybdenum and platinum.

In paragraph 6 of the Office action, the Examiner alleged that Koizumi '320 discloses a needle-shaped conductive material selected from the group recited in previous dependent claims 2 and 24, respectively. However, a review of Koizumi '320 reveals that the materials recited as members of the group set forth in dependent claims 2 and 24 are not disclosed or suggested in Koizumi '320.

In the latter regard, it should be noted that Koizumi '320 discloses carbonate as a

mere starting material for forming alkaline earth metal oxide, and the carbon in the carbonate is evaporated at a subsequent heating step (1000°C) and does not remain in the resultant cathode. On the other hand, the composition of the present invention further includes pure carbon in addition to carbonate for forming alkaline earth metal oxide. Since the carbon of the present invention is not evaporated at the subsequent step and remains in the cathode, it is distinguishable from the carbonate of Koizumi '320.

In paragraph 13 of the Office action, the Examiner alleged that Uemura '547 also discloses the needle-shaped conductive material as comprising materials selected from the group recited in dependent claims 2 and 24, respectively. However, a careful review of that patent, and especially the portion cited by the Examiner (column 2, lines 48-53), reveals that Uemura '547 does not disclose or suggest the materials which are members of the group recited in previous dependent claims 2 and 24, respectively. In fact, the portion cited by the Examiner (column 2, lines 48-53) in Uemura '547 merely refers to the electron-emitting sources as being made of carbon nanotubes formed from a graphite layer, the carbon nanotubes being formed from a multi layer graphite column, a plurality of carbon nanotubes aggregating to a needle-like structure.

Thus, neither Koizumi '320 nor Uemura '547 discloses or suggests the materials now recited in independent claims 1 and 23 as being candidates for the needle-shaped conductive material or the electron-emitting material layer recited in those claims. On

this basis, the invention recited in independent claims 1 and 23 is distinguishable from the prior art cited by the Examiner so as to preclude rejection under 35 U.S.C. §102 or §103.

Dependent claims 4 and 26 are being amended to appear in independent form. In that regard, in paragraph 15 of the Office action, the Examiner alleged that Uemura '547 discloses the carbonaceous material as being selected from the group consisting essentially of a carbon nanotube, carbon fiber and graphite fiber (the Examiner citing column 2, lines 48-53 of Uemura '547). However, as indicated above, a review of the cited portion of Uemura '547 fails to reveal any mention of carbon fiber or graphite fiber. That is to say, whereas carbon and graphite are mentioned in connection with carbon nanotubes and a graphite layer, there is no specific reference in Uemura '547 to the use of carbon fiber and graphite fiber as candidates for the carbonaceous material forming the needle-shaped conductive material of the electron-emitting material layer recited in the claims. On this basis, the invention recited in independent claims 4 and 26 is distinguishable from the prior art so as to preclude rejection under 35 U.S.C. §102 or §103.

Furthermore, it should be noted that Uemura '547 discloses a needle shape material, but has a different technical field from the present invention since Uemura '547 relates to an electron emitting source, while the present invention relates to a cathode for

an electron tube. Also, as to the composition of the layer, Uemura '547 uses only carbon nanotube, but the present invention uses a paste mixture of carbon nanotube, carbonate, metal alkoxide *etc.* Thus, in this respect, the present invention is distinguishable from Uemura '547.

Dependent claims 6 and 28 are being amended to appear in independent form. In that regard, in paragraph 21 of the Office action, the Examiner alleged that Koizumi '320 and Uemura '547 disclose the features recited in previous dependent claims 6 and 28, but the Examiner admitted that the two patents fail "to exemplify the needle-shaped conductive material in the electron-emitting material layer being in the range of 0.01 to 30% by weight based on the total weight of the electron-emitting material" (quoting from paragraph 21 of the Office action). However, the Examiner rejected those claims under 35 U.S.C. §103 based on the allegation that it would have been obvious to one of ordinary skill in the art to provide the electron-emitting material layer of Koizumi '320 and Uemura '547 with "the above mentioned amount of conductive material and the above mentioned thickness, since where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art" (quoting from paragraph 22 of the Office action). Applicant respectfully disagrees.

Specifically, in order that it be obvious to make modifications or additions to the disclosure of Koizumi '320 and Uemura '547, those disclosures must contain some

suggestion or motivation to make the changes in question to the disclosures of those respective patents. In this case, the patents do not contain such motivation or instruction, and the Examiner has not cited any portion of the patents containing such motivation or instruction. Thus, it must be considered non-obvious to arrive at the features of the invention recited in independent claims 6 and 28, respectively. In fact, the specification of the present application sets forth specific reasons why the provision of needle-shaped conductive material in a range of 0.1 to 30% by weight based on a total weight of the electron-emitting material achieves advantageous and unexpected results. Specifically, as stated in paragraph [0063] of the specification, when the content of the conductive powder is less than 0.01% by weight, the electrical conductivity of the electron-emitting material layer is not high enough to effectively reduce the Joule heat. Moreover, if the content of the conductive power is more than 30% by weight, the amount of the electron-emitting material is relatively reduced, and this may adversely affect electron emission characteristics. These results are unique and non-obvious results discovered by the inventors after substantial experimentation. Thus, the features of the invention now recited in independent claims 6 and 28 are non-obvious features, and would not have been obvious to a person of ordinary skill in the art as of the date of the invention. On this basis, the invention recited in independent claims 6 and 28 is distinguishable from the prior art so as to preclude rejection under 35 U.S.C. §103.

Independent claim 10 is being amended to improve its form only. It is respectfully

submitted that the invention recited in independent claim 10 is distinguishable from the prior art so as to preclude rejection under 35 U.S.C. §102 or §103.

In that regard, in paragraph 9 of the Office action, the Examiner alleges that Figure 1 of Koizumi '320 shows a surface roughness corresponding to a distance between the highest point and the lowest point on the surface of the electron-emitting material layer being less than 10 microns. However, a review of Figure 1 of Koizumi '320 merely discloses an electron-emitting layer 3 disposed on a nickel base metal 2, with a cathode sleeve 1 arranged around element 6. Neither Figure 1 nor any related discussion in Koizumi '320 discusses surface roughness, much less in the manner as such is recited in independent claim 10. Thus, Koizumi '320 does not disclose or suggest the invention as recited in independent claim 10.


Furthermore, independent claim 10 recites a surface roughness in terms of having high and low peaks of needle shape on the surface of a layer comprising several components (paste, metal oxide, *etc.*). Therefore, the surface roughness of the present invention is quite different from the surface of the simple metal oxide layer disclosed in Figure 1 of Koizumi '320. Further, Figure 9B of Uemura '547 discloses a scanning step involving a laser beam directed perpendicular to an electron emitting surface, and thus bears no relationship to the surface roughness of the present invention.

Finally, new independent method claim 35 is being added to the application in order to provide the complete protection to which the Applicants are believed to be entitled. It is respectfully submitted that the prior art does not disclose or suggest the method recited in independent claim 35 and associated dependent claims 36 thru 47, and for that reason, the invention recited in independent claim 35 and its associated dependent claims is distinguishable from the prior art so as to preclude rejection under 35 U.S.C. §102 or §103.

In view of the above, it is submitted that the claims of this application are in condition for allowance, and early issuance thereof is solicited. Should any questions remain unresolved, the Examiner is requested to telephone Applicant's attorney.

A fee of \$510.00 is incurred by the addition of five (5) independent claims in excess of total 3 and five (5) total claims in excess of total 34. Applicant's check drawn to the order of Commissioner accompanies this Amendment. Should the check become lost, be deficient in payment, or should other fees be incurred, the Commissioner is authorized to charge Deposit Account No. 02-4943 of Applicant's undersigned attorney in the amount of such fees.

Respectfully submitted,


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